

We claim:

1. *An electronic non-contacting linear position measuring system,*
comprising:

an electrical transmission line of at least two parallel conductors
helically twisted with a pitch wavelength that is large compared to the spacing
5 between said two parallel conductors, wherein said pitch wavelength is constant
along said line and defines a characteristic unit of distance;

a radio-frequency (RF) current source configured to provide RF
current into said transmission line, wherein a time-varying magnetic field having
both azimuthal and radial components will be induced in the vicinity of said
10 transmission line;

at least one nested coil comprising a first coil and a second coil
orthogonally nested together, and attached to an object, wherein said first coil
and said second coil have about the same area and the same number of turns of
wire, wherein said first coil has its axis pointing toward the symmetry axis of
15 said transmission line and thus will intercept said radial component to produce a

corresponding radial signal, wherein said second coil has its axis oriented at 90 degrees to said first coil so that it will intercept said azimuthal component to produce a corresponding azimuthal signal; and

20 means for calculating the instantaneous position of said object with respect to said transmission line based on said azimuthal signal and said radial signal.

2. The system of claim 1, wherein said means includes electronics and a full-wave rectifier to full-wave rectify said radial signal and said azimuthal signal before being processed by said electronics.

3. The system of claim 1, wherein said means includes electronic circuitry configured to take the ratio of said azimuthal signal and said radial signal.

4. The system of claim 1, wherein said means includes electronic circuitry configured to take the ratio of said azimuthal signal and said radial signal to produce periodic fiducial marks.

5. The system of claim 1, wherein said means includes electronic circuitry configured to take the ratio of said azimuthal signal and said radial signal to produce periodic fiducial marks with a spacing corresponding exactly to a half-wavelength of said transmission line, wherein said means are
5 configured to use said fiducial marks to determine the position of said first coil and said second coil relative to said transmission line.

6. The system of claim 4, wherein said electronic circuitry is further configured to calculate the Arc Tangent of the ratio of said azimuthal signal and said radial signal to produce a series of triangular waves between said fiducial marks as said nested coil moves with respect to said transmission line, wherein
5 the amplitude of said triangular waves at any phase position between their minimum and maximum value is linearly related to location between the marks such that the position at any point between said fiducial marks may be directly measured.

7. The system of claim 1, wherein said RF current source is configured to provide RF current into said transmission line by providing current directly into said first coil and said second coil, wherein RF voltages are induced in said transmission line.

8. The system of claim 7, wherein said RF current source is configured to provide a first current directly into said first coil and a second current directly into said second coil, wherein said first current and said second current differ slightly from each other in frequency, wherein these RF currents will then induce RF voltages in said transmission line the relative amplitude of which will be a function of the position of said nested coils along said transmission line.

9. The system of claim 8, wherein said means includes frequency-selective circuits followed by detection and amplitude-comparison to electronically extract the necessary positional information.

10. The system of claim 1, further comprising a radio link and a receiver, wherein said radio link is operatively connected and positioned to report fractional parts of said unit of distance and sums thereof to said receiver.

11. The system of claim 1, wherein said nested coil is operatively attached to a magnetic levitation car, wherein said transmission line is operatively connected to a magnetic levitation track.

12. The system of claim 1, wherein to calculate the position of said object, a relative known starting position of said object must be known, wherein said relative known starting position is selected from the group consisting of a gap in said transmission line, a sudden change in the polarity of said
5 transmission line and a signal placed at points along said transmission line.

13. A method for measuring the position of a moving object along a track, comprising:

providing an electrical transmission line of two parallel conductors helically twisted with a pitch wavelength that is large compared to the spacing
5 between said two parallel conductors, wherein said pitch wavelength is constant along said line and defines a characteristic unit of distance;

inputting RF current into said transmission line, wherein a time-varying magnetic field having both azimuthal and radial components will be induced in the vicinity of said transmission line;

10 providing a nested coil comprising a first coil and a second coil orthogonally nested together, and attached to an object, wherein said first coil and said second coil have about the same area and the same number of turns of wire, wherein said first coil has its axis pointing toward the symmetry axis of said transmission line and thus will intercept said radial component to produce a
15 corresponding radial signal, wherein said second coil has its axis oriented at 90

degrees to said first coil so that it will intercept said azimuthal component to produce a corresponding azimuthal signal; and

calculating the instantaneous position of said object with respect to said transmission line based on said azimuthal signal and said radial signal.

14. The method of claim 13, wherein the step of calculating the instantaneous position of said object is carried out with electronics and a full-wave rectifier to full-wave rectify said radial signal and said azimuthal signal before being processed by said electronics.

15. The method of claim 13, wherein the step of calculating the instantaneous position of said object is carried out with electronic circuitry configured to take the ratio of said azimuthal signal and said radial signal.

16. The method of claim 13, wherein the step of calculating the instantaneous position of said object is carried out with electronic circuitry configured to take the ratio of said azimuthal signal and said radial signal to produce periodic fiducial marks.

17. The method of claim 13, wherein the step of calculating the instantaneous position of said object is carried out with electronic circuitry configured to take the ratio of said azimuthal signal and said radial signal to produce periodic fiducial marks with a spacing corresponding exactly to a half-wavelength of said transmission line, wherein said means are configured to use said fiducial marks to determine the position of said first coil and said second coil relative to said transmission line.

18. The method of claim 16, wherein said electronic circuitry is further configured to calculate the Arc Tangent of the ratio of said azimuthal signal and said radial signal to produce a series of triangular waves between said fiducial marks as said nested coil moves with respect to said transmission line, wherein the amplitude of said triangular waves at any phase position between their minimum and maximum value is linearly related to location between the marks such that the position at any point between said fiducial marks may be directly measured.

19. The method of claim 14, wherein the step of inputting RF current is carried out with an RF current source configured to provide RF current into said

transmission line by providing current directly into said first coil and said second coil, wherein RF voltages are induced in said transmission line.

20. The method of claim 19, wherein said RF current source is configured to provide a first current directly into said first coil and a second current directly into said second coil, wherein said first current and said second current differ slightly from each other in frequency, wherein these RF currents will then induce RF voltages in said transmission line the relative amplitude of which will be a function of the position of said nested coils along said transmission line.

20. The method of claim 20, wherein the step of calculating the instantaneous position of said object is carried out with frequency-selective circuits followed by detection and amplitude-comparison to electronically extract the necessary positional information.

21. The method of claim 13, further comprising providing a radio link and a receiver, wherein said radio link is operatively connected and positioned to report fractional parts of said unit of distance and sums thereof to said receiver.

22. The method of claim 13, wherein said nested coil is operatively attached to a *magnetic levitation car*, wherein said *transmission line* is operatively connected to a magnetic levitation track.

23. The method of claim 13, wherein to calculate the position of said object, a *relative known starting position of said object* must be known, wherein said relative known starting position is selected from the group consisting of a gap in said transmission line, a sudden change in the polarity of said
5 *transmission line* and a signal placed at points along said transmission line.